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(54) A METHOD OF TESTING FOR GAS-TIGHTNESS A BREATHING MASK ON A WEARER AND APPARATUS FOR USE IN THE METHOD

(71) We, Drägerwerk Aktiengesellschaft, a German Company, of Moislinger Allee 53–55, 2400 Lübeck, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

This invention relates to a method of testing for gas-tightness a breathing mask on a wearer and an apparatus for use in the method.

According to one aspect of the present invention, there is provided a method of testing for gas-tightness a breathing mask on a wearer, comprising putting over the mask and the wearer's head a hood in such a manner that an exhalation gas outlet of the mask is sealingly encircled by holding means of said hood holding measuring means, and feeding an indicating gas into the interior space of said hood, whereby leakages from said hood into said mask result in the presence of said indicating gas in the exhalation gas and thus in said measuring means.

According to another aspect of the present invention, there is provided an apparatus for use in testing for gas-tightness a breathing mask on a wearer, comprising a hood for putting over the mask and the wearer's head and including holding means for sealingly encircling an exhalation gas outlet of said mask, and for measuring means held by said holding means for receiving exhalation gas, said hood also including feeding means for feeding indicating gas into the interior space of said hood.

Owing to the invention it is possible to carry out a test foc gas-tightness without any great outlay at any time, such as during, and after, the issuing of breathing masks to the actual wearer, for example in fire brigades, industrial concerns and in mine rescue situations.

In a preferred embodiment of the present apparatus the holding means extends in a gas-tight manner through the material of the hood for as in use to be positioned opposite an exhalation valve of the mask, comprises internally a gripping ring adapted to be applied in a gas-tight manner to a housing of the exhalation valve, and comprises externally a tubular mounting, a gas detector tube containing a colour-changing reagent being inserted in the mounting. For still more sensitive quantitative determination of leakage, the gas detector tube is connected at its gas outlet with a measuring bag.

The advantages which are thereby obtained consist particularly in that the use of the *per se* known detector tube method, which is a generally recognised method for gas measurement, allows a simple test for gas-tightness when the breathing mask is on the wearer, and the test can be carried out anywhere. The hood and the detector tube can easily be transported and can be used any any time independently of an energy supply. It is possible to detect directly the degree of any leakage, or gas-tightness, from the length of the discolouration at the detector tube and from non-discolouration, respectively. A measurement value scale on the detector tube not only makes it possible to fix the critical value of a leakage rate which may be just permitted, but also makes it possible to determine the actual leakage rate more precisely.

A further advantageous possibility for determining the proportion of test gas in the exhalation air is obtained with a measuring bag which is inserted directly in the mounting. When testing is being carried out, the exhalation gas is blown directly from the exhalation valve into the measuring bag. Then an appropriate gas detector tube is inserted in the removed measuring bag and the exhalation air is drawn by suction by means of a gas detector pump from the measuring bag

through the detector tube. Again the degree of leakage can be concluded from the length of discolouration.

The test gas is preferably a breathable mixture with an addition of ethylene as the indicating gas. The proportion of ethylene can amount to about 2%. Ethylene is a *per se* known available gas. By choosing a proportion of 2% it is possible to keep reliably below the lower ignition limit of 2.7% by volume. Suitable detector tubes are commercially available for ethylene.

For an advantageously simple connection of a breathing apparatus to the breathing mask, a connecting union of the mask is encircled in a gas-tight manner by the hood in an aperture therein. This arrangement makes it possible to fit-on the breathing mask in a gas-tight manner in a normal atmostphere, even without the breathing apparatus connected.

In order that the invention may be clearly understood and readily carried into effect, reference will now be made, by way of example, to the accompanying drawing, which shows a diagrammatic, sectional, side elevation illustrating the testing for gas-tightness of a breathing mask on a wearer.

Referring to the drawing, the breathing mask 1 with an inner mask part 2 is intended to lie in a gas-tight manner with a sealing frame 3 against corresponding parts of the mask wearer's face. The inner mask part 2 directs inhalation gas over the inside of a mask window 4 to ensure that the window 4 is kept clear of condensation. A testing apparatus comprising substantially a head hood 5, which surrounds the head of the wearer and is made of a material 10 foc example a transparent plastics sheet material, with an exhalation air connection 6 into a tubular outer mounting 7 of which a gas detector tube 8 (shown in a separate fragmentary view in the drawing) containing a colour-changing reagent is inserted. The exhalation air connection 6 comprises internally a gripping ring which can be put on to an exhalation valve housing 9 of the mask. The hood 5 is provided with an aperture 12 holding, sealed by means of a rubber ring 13, a connecting union 14 of the breathing mask 1. The breathing mask can be fitted in a gas-tight manner to the wearer without the breathing apparatus being connected to the union 14. In that case, breathing air is supplied by inhaling the normal ambient atmosphere. The hood 5 is closed about the neck of the wearer by a collar 15 so as to be sealed relatively to the ambient atmosphere. The collar 15 can expand in order to allow the hood 5 to be put on.

A test gas bottle 16 is connected by way of a flexible connecting tube 17 to the hood 5 for supplying the interior space thereof with test gas. By means of a flow regulating arrangement 19 the test gas is introduced in a dosaged manner into the hood 5. With the ring 11 put on to the exhalation valve housing 9, a measuring bag 18 collects the exhalation gas issuing through the gas detector tube 8. The gas filling of the bag is a measure of the quantity of exhalation gas.

To test the gas-tightness of the breathing mask 1 which has been put on, the hood 5 is drawn over the head of the wearer. The ring 11 of the exhalation air connection 6 can first of all be left spaced from the exhalation valve housing 9. The hood 5 is then cleaned out by the first breaths which are taken. After several breathing cycles the ring 11 is pressed on to the exhalation valve housing 9 and then the gas detector tube 8 is inserted in a gas-tight manner intm the mounting 7. After the filling of the interior of the hood 5 with test gas, the test gas can penetrate during breathing through any leakages at the sealing frame 3 of the breathing mask 1 or through any leakages in the mask itself into the interior of the mask. It mixes with the inhalation gas which is drawn in directly from the ambient atmosphere or through the breathing apparatus. When the exhalation gas flows through the detector tube 8, a reaction then takes place in accordance with the quantity of test gas admixed and this reaction results in discolouration. The length of the discolouration is a measure of the leakage at the breathing mask.

The additional use of the measuring bag 18 at the outlet of the detector tube 8 allows measurement results to be obtained much more accurately if necessary.

WHAT WE CLAIM IS:–

1. A method of testing for gas-tightness a breathing mask on a wearer, comprising putting over the mask and the wearer's head a hood in such manner that an exhalation gas outlet of the mask is sealingly encircled by holding means of said hood holding measuring means, and feeding an indicating gas into the interior space of said hood, whereby leakages from said hood into said mask result in the presence of said indicating gas in the exhalation gas and thus in said measuring means.

2. A method as claimed in claim 1, wherein said feeding comprises feeding into said interior space a breathable gas mixture including ethylene as said indicating gas.

3. A method as claimed in claim 2, wherein the proportion of ethylene in said gas mixture is about 2%.

4. A method as claimed in any preceding claim, wherein said hood is put over as aforesaid also in such manner that an inhalation gas inlet of said mask is sealingly encircled by an annular sealing member of said hood.

5. A method as claimed in any preceding claim, and further comprising reading

said measuring means, which is a detector tube for said indicating gas.

6. A method as claimed in any one of claims 1 to 4, and further comprising removing said measuring means, which is a measuring bag, from said holding means, passing the contents of said measuring means through a detector tube for said indicating gas, and reading said detector tube.

7. Apparatus for use in testing for gastightness a breathing mask on a wearer, comprising a hood for putting over the mask and the wearer's head and including holding means for sealingly encircling an exhalation gas outlet of said mask, and measuring means held by said holding means for receiving exhalation gas, said hood also including feeding means for feeding indicating gas into the interior space of said hood.

8. Apparatus as claimed in claim 7, wherein said measuring means comprises a detector tube.

9. Apparatus as claimed in claim 8, wherein said detector tube serves to detect ethylene.

10. Apparatus as claimed in claim 8 or 9, wherein said measuring means includes a measuring bag connected to the downstream end of said detector tube.

11. Apparatus as claimed in claim 7, wherein said measuring means comprises a measuring bag.

12. Apparatus as claimed in any one of claims 7 to 11, wherein said hood further comprises an annular sealing member for sealingly encircling an inhalation gas inlet of said mask.

13. A method of testing for gastightness a breathing mask on a wearer, substantially as hereinbefore described with reference to the accompanying drawing.

14. Apparatus for use in testing for gastightness a breathing mask on a wearer, substantially as hereinbefore described with reference to the accompanying drawing.

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1546550 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*